

REMARKS

Claims 23-35, 37-44, 63-68 and 80-95 remain in this application. Claims 23, 24 and 43 have been amended. Claim 36 has been canceled. Claims 80-95 have been added. Claims 23, 43, 63, 67, 68 and 82 are independent claims.

In the Office action dated August 31, 2005: claims 63-68 were allowed; claims 23-39, 41, 43 and 44 were rejected under 35 U.S.C. 102(b) as allegedly being anticipated by U. S. Patent No. 6,312,134 B1 to Jain et al.; and claims 40 and 42 were objected to as being dependant upon a rejected base claim.

In response to the rejections, Applicant has amended independent claims 23 and 43, as well as various dependent claims, and has added claims 80-95, in order to more clearly distinguish the claimed invention from the cited prior art.

Please note that in the claims as originally filed Applicant was using 'spatial light modulator' (SLM) to refer to one or more 'spatial light modulator arrays', where each array is a separate device. Support for this original usage is found throughout the detailed description - for example, the multiple devices shown in Fig. 5 are together described as being 'an SLM' (see description in paragraph 52 of Applicant's published application, US 2004/0075882 A1). However, Applicant is now aware that this usage is confusing and Applicant has adopted a more natural usage for the term 'spatial light modulator' - in the amended claims 'spatial light modulator' refers to only one device or array. Consequently, original independent claim 23, which covered one or more arrays, has been replaced by amended independent claim 23 (covering a single array)

and new independent claim 82 (covering a plurality of arrays). Dependent claim 24 has been amended to be consistent with the amended independent claim 23. Dependent claim 36 has been canceled, since it is no longer consistent with amended independent claim 23. (New claim 94, dependent on new independent claim 82, effectively replaces the original claim 36.) Independent claim 43 has been amended to unambiguously claim a plurality of spatial light modulators.

New dependent claims 80, 81 and 83-95 were added to provide more detail of the lithography tool. Support for these new claims may be found in various locations within the application as originally filed. All references in this paragraph will be to the Applicant's published application, US 2004/0075882 A1. For example, a description of diffractive spatial light modulators and LCD spatial light modulators can be found in paragraph 47. Claims 83-92 are based on embodiments of the invention such as those shown in Figs. 5 and 29 and described in paragraphs 52 and 107. Claims 93-95 are based on embodiments of the invention such as those shown in Fig. 5 and described in paragraph 52.

In view of the amendments and the remarks that follow, Applicant respectfully asserts that the claims are in a condition for allowance.

A. Patentability of Amended Independent Claim 23

In the determination of patentability of claim 23, the Office action alleges that Jain et al. disclose an imaging optics configured to project a blurred image of a spatial light modulator on a substrate. Applicant respectfully asserts that this is a misinterpretation of Jain et al. Column 7, lines 61-67 and col. 8 lines 1-2, of

Jain et al. describe the parameters for operation of Jain's lithography tool in order to avoid blurring of the image projected onto the substrate. The sentence in column 8, lines 1-2 refers to a condition that is not desired. Further support for this conclusion is found in col. 7, lines 24-44 where Jain et al. describes criteria required to "ensure that the pattern imaged onto the substrate is *not* blurred." (Emphasis added.) Furthermore, the blurring that Jain is referring to is due to the substrate moving in the x-y plane during exposure by the projected image of the SLM. (Jain et al. col. 11, lines 20-32, refers to Fig. 1 and states that "[e]ach point of the substrate 5 that is to be patterned is illuminated by several different pulses as the stage 6 carries the substrate 5 through the illumination beam pattern 31.")

Jain's desire to avoid blurring due to movement of the patterned image across the substrate is apparent from the calculations in col. 8, lines 5-10. With a stage speed of 250 mm/s and a pulse duration of 40 ns, the substrate will have moved 0.01 μm during exposure by the patterned image. This is very small compared to a desired minimum feature size of 1 μm ; consequently, there will be no appreciable blurring.

The Office action also cites col. 8, lines 30-34. This citation describes a seamless scanning technology, which includes a high resolution projection lens. At col. 8, lines 61-66 this projection lens is described as forming a precise image on the substrate. Jain et al. does not disclose projection optics configured to produce a blurred image on the substrate.

In preferred embodiments of Applicant's invention the imaging optics is configured to project a blurred image of the spatial light modulator on the

substrate. Blurring the image is required in Applicant's method of achieving sub-pixel resolution feature edge placement. Applicant's method is described by Figs. 10-27 and related discussion in the detailed description.

In summary, Jain et al. discusses blurring due to movement of the patterned image across the substrate and teaches that such blurring is undesirable. Jain et al. discloses only projection optics configured to produce a precise image on the substrate. In contrast, Applicant teaches that blurring is desirable and claims imaging optics configured to blur the image on the substrate. Consequently, Applicant's lithographic tool described in claim 23 is patentably distinguishable from the lithographic tool of Jain et al.

In view of the amendments and above remarks, Applicant respectfully asserts that claim 23 and its dependent claims are allowable over Jain et al.

B. Patentability of Dependent Claim 29

Further consideration will now be given to the patentability of dependent claim 29. In the determination of patentability of claim 29, the Office action cites Jain et al. col. 8, lines 18-21, which refers to a continuous wave (CW) light source. However, a quasi-continuous laser, also known as a quasi-continuous wave (QCW) laser, is not a CW light source. QCW is a term of art in the laser industry which is clearly differentiated from the term CW. A laser is considered to be a QCW source in lithography applications when operated at very high pulse repetition rates, typically in excess of 80MHz. See US 6,421,573 to Kafka et al. col. 5, lines 28-31. In paragraph 47 of Applicant's published application, US

2004/0075882 A1, a quasi-continuous laser is described as a laser that is operated at MHz frequencies. In Applicant's tool it is important that the frequency of the quasi-continuous laser is much higher than the switching frequency of the spatial light modulator, which is of the order of 10^4 Hz.

In view of the above remarks, Applicant respectfully asserts that claim 29 is allowable over Jain et al.

C. Patentability of Dependent Claim 30

Further consideration will now be given to the patentability of dependent claim 30. In the determination of patentability of claim 30, the Office action cites Jain et al. col. 7, lines 16-18, which states that "illuminated DMD pixels which are reflective are imaged by a projection lens 4 onto a substrate 5" However, Jain does not describe a telecentric projection lens system, as claimed by Applicant. A telecentric projection lens system is a special projection lens system such as shown in Applicant's figures 4 and 6. These figures demonstrate that when a telecentric projection lens is used there is no change in magnification of the image projected onto the substrate with variation in position of the substrate along the z-axis. If conventional projection lenses are used instead, the magnification does change along the z-axis. In lithography applications the magnification must be kept constant in order to control feature size and placement on the substrate; consequently, telecentric lens systems are advantageous for patterning non-flat substrates.

In view of the above remarks, Applicant respectfully asserts that claim 30 is allowable over Jain et al.

D. Patentability of Dependent Claim 31

Further consideration will now be given to the patentability of dependent claim 31. In the determination of patentability of claim 31, the Office action cites Jain et al. col. 7, lines 19-23 which discusses the reduction power of the projection lens. The reduction power is the demagnification of the lens – the example given in lines 21-22 makes this clear. In the example, an image, with pixels one tenth of their actual size, is projected onto the substrate. In contrast, Applicant is blurring the image by defocusing the image – this can be achieved by changing the distance between the projection lens and the substrate by a small amount, so that the substrate is no longer in the focal plane of the lens. Defocusing the image does not change the magnification of the image.

In view of the above remarks, Applicant respectfully asserts that claim 31 is allowable over Jain et al.

E. Patentability of Dependent Claim 32

Further consideration will now be given to the patentability of dependent claim 32. Considering the discussion relating to the patentability of independent

claim 23, the use of a diffuser is not inherent since Jain et al. does not disclose imaging optics configured to project a blurred image on the substrate.

In view of the above remarks, Applicant respectfully asserts that claim 32 is allowable over Jain et al.

F. Patentability of Dependent Claim 33

Further consideration will now be given to the patentability of dependent claim 33. In the discussion relating to the patentability of independent claim 23, it is established that Jain et al. does not disclose imaging optics configured to project a blurred image on the substrate. Consequently, it follows that Jain also does not disclose adjustment of the numerical aperture (NA) of the projection lens to blur the image.

In view of the above remarks, Applicant respectfully asserts that claim 33 is allowable over Jain et al.

G. Patentability of Dependent Claim 34

Further consideration will now be given to the patentability of dependent claim 34. In the determination of patentability of claim 34, the Office action alleges that Jain et al. col. 10, line 33 describes a microlens array. This reference is to a line in a paragraph which describes the structure of a specific spatial light modulator known as a deformable micromirror device (DMD). A

DMD is comprised of an array of mirrors. In contrast, a microlens array is a transmissive lens which is composed of many small lenses arranged in an array, for example a fly's eye lens. Jain et al. does not disclose a microlens array.

In view of the above remarks, Applicant respectfully asserts that claim 34 is allowable over Jain et al.

H. Patentability of Dependent Claims 38 and 39

Further consideration will now be given to the patentability of dependent claims 38 and 39. In the determination of patentability of claims 38 and 39, the Office action cites Jain et al. col. 7, lines 13-18, which describes the configuration of elements in Fig. 1 as "illuminated DMD pixels which are reflective are imaged by a projection lens 4 onto a substrate 5 which rests on a scanning stage 6." This sentence should be read to mean that only substrate 5 rests on scanning stage 6. This interpretation is apparent from Fig. 1 which shows only substrate 5 on scanning stage 6. Furthermore, the Jain invention does not work if all of the DMD, projection lens and substrate move together on the same stage, since the image of the DMD must be scanned across the substrate. (See Jain et al. col. 11, lines 20-32, which refers to Fig. 1 and states that "[e]ach point of the substrate 5 that is to be patterned is illuminated by several different pulses as *the stage 6 carries the substrate 5 through the illumination beam pattern 31.*" (Emphasis added.) Consequently, Jain does not describe a lithography tool in which the spatial light modulator and/or the imaging optics is carried on a stage.

In view of the above remarks, Applicant respectfully asserts that claim 38, and its dependent claim, are allowable over Jain et al.

I. Patentability of Amended Independent Claim 43

As discussed above, claim 43 has been amended to unambiguously describe the spatial light modulator as "a plurality of spatial light modulators." The discussion relating to the patentability of amended claim 23 applies here. Consequently, Applicant's lithographic tool described in claim 43 is patentably distinguishable from the lithographic tool of Jain et al.

In view of the amendments and above remarks, Applicant respectfully asserts that claim 43 and its dependent claim are allowable over the cited prior art.

J. Patentability of New Independent Claim 82

As discussed above, new independent claim 82 is derived from original claim 23. The discussion relating to the patentability of amended claim 23 applies here. Consequently, Applicant's lithographic tool described in claim 82 is patentably distinguishable from the lithographic tool of Jain et al.

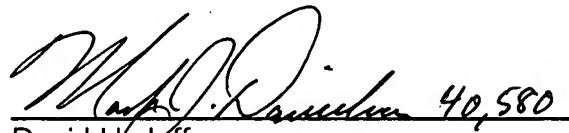
CONCLUSION

In view of the amendments and above remarks, Applicant respectfully asserts that claim 82 and its dependent claims are allowable.


Applicant respectfully requests that a Notice of Allowance be issued for this application.

Respectfully submitted,

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